Technology Opportunity

Packaging Technology Operable to 500 °C for High-Temperature Microsystems

The Sensors and Electronic Technology Branch of the NASA Glenn Research Center (GRC) is actively developing and validating electronic packaging technology for high-temperature electronics, sensors, and MEMS operable at temperatures up to 500 °C. We are seeking potential industry partners for cooperative application, development, and commercialization of this advanced high-temperature-operable packaging technology for various microsystems.

Potential Commercial Uses

This advanced electronic packaging technology extends the maximum operation temperature of packaging systems to 500 °C, which, though significantly higher than the high-temperature limit of the packaging technology currently available on the market, is necessary for the following applications:

- Packaging for high-temperature electronics and devices: SiC-based electronics
- Packaging for high-temperature electronic sensors: gas (C_XH_Y) chemical sensors and electronic circuits for signal processing
- Packaging for harsh environment-operable microsystems: high-temperature MEMS sensors and electronic support and control systems
- Packaging for high-temperature fire, smoke, and fuel-leak detection sensors and signal processing electronics

Benefits

High-temperature-operable electronic packaging is an essential part of high-temperature electronics, sensors, and microsystems. Commercialization of this packaging technology will expedite the infusion of high-temperature electronic sensors and devices into space, aeronautic, and civil applications.

The Technology

Various high-temperature SiC electronic devices and sensors have recently been demonstrated to be operable at high temperatures, but only in the probe station environment because the essential packaging technology suitable for high-temperature operation (500 °C and above) has not been commercially available. Therefore, high-temperature packaging technology is an immediate need for in situ characterization and testing and commercialization of SiC-based high-temperature sensors, electronics, and microsystems.

NASA GRC has developed inhouse a high-temperature electronic packaging technology for operation up to 500 °C. All the materials and processes for basic packaging components are innovative for high-temperature (500 °C) and harsh environment (e.g., under the effects of corrosion) operation. Based on ceramics and noble metals, this packaging technology can accommodate various physical and chemical sensors, electronic devices and circuits, and microsystems for high-temperature operation.

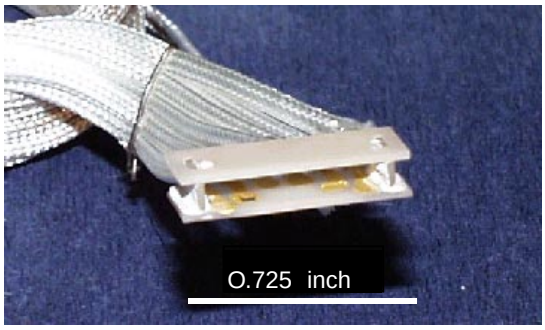

Figure 1.–Prototype high-temperature electronic package designed for a gas chemical sensor. It was tested at 500 °C.

The prototype electronic package designed, fabricated, and assembled at NASA GRC survived a soak test at 500 °C in air. Packaging components tested include internal wire and wire bonds, external lead bonds, and SiC (diode) chip die-attach. One of the test loops was composed of printed wire, wire bonds, and lead bonds subjected to a DC current load at 500 °C. As desired, the electrical resistances of the test loops (of thick-film printed wires, wire bonds, and lead bonds) soaked at 500 °C with or without current load were low and very stable. Also as expected, the electrical isolation impedance between printed wires that were not electrically jointed by a wire bond remained high during and after the 500 °C soak test. The characterization of the attached SiC die (diode) showed low resistance of backside electrical contact through die-attach at both room temperature and 500 °C.

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Figure 1 shows a picture of the tested prototype package with high-temperature test leads. This prototype package is designed for a gas sensor; therefore, the packaging system is open and the SiC semiconductor die (diode) attached is visible.

Options for Commercialization

This high-temperature packaging technology has not been licensed. We are seeking industry partner(s) for both potential application and commercialization. The options for our partners can be at the levels of both packaging specific devices, and materials and components technology.

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